JOYSTICK INTERFACE BOARD

INTERCONNECTION DESCRIPTION

The connector is DB9P type; the pin function is the following:

Pin	Function
1	+5V (100 mA)
2	Rx data
3	Tx data
4	
5	
6	
7	
8	Ground
9	

An external power supply 5V±5% is requested.

COMMUNICATION PROTOCOL

Standard	RS232C
Baud Rates:	settable (default 19200)
Parity:	even
Data bits:	8
Stop bit:	1
Transmission frequency	8.33 Hz

DATA FRAME:

$ Ux Uy Uz Wx Wy Wz S CHK

DESCRIPTION:

The transmission speed is settable by the dip-switch S1 according to the following table:

BAUD RATE	S1-1	S1-2	S1-3	S1-4
1200	OFF	OFF	OFF	/
2400	ON	OFF	OFF	/
4800	OFF	ON	OFF	/
9600	ON	ON	OFF	/
19200	OFF	OFF	ON	/

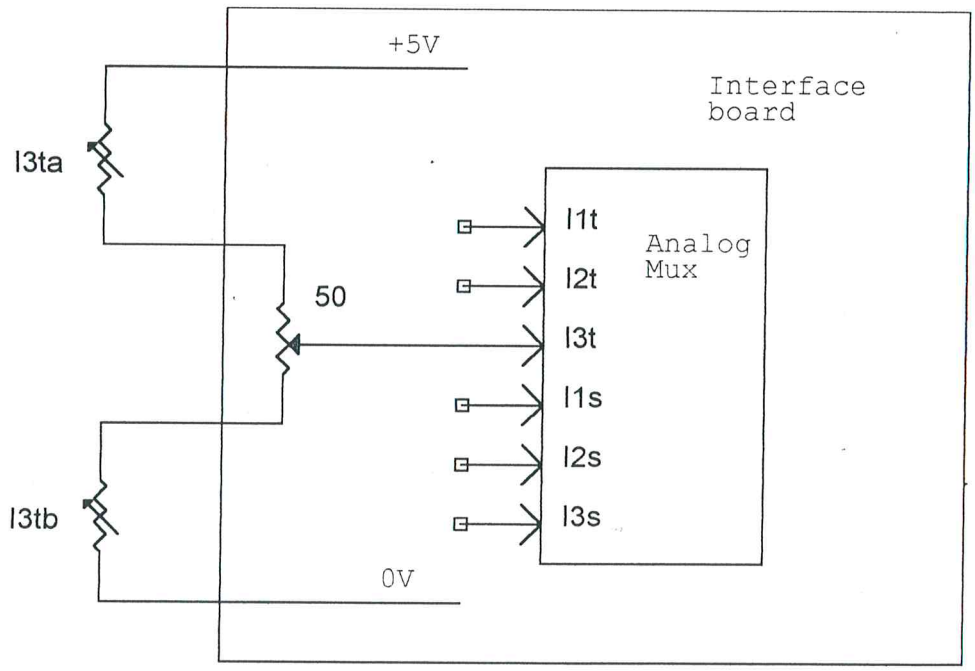
The meaning of the transmitted data is:

$	identification character	
Ux	datum: x axis force (from 80H to 7FH)	(HEX base)
Uy	datum: y axis force (from 80H to 7FH)	
Uz	datum: z axis force (from 80H to 7FH)	
Wx	datum: x axis moment (from 80H to 7FH)	
Wy	datum: y axis moment (from 80H to 7FH)	
Wz	datum: z axis moment (from 80H to 7FH)	
S	datum: input switches 0÷7	
CHK	data frame checksum: LSB of the sum of the previous 8 bytes	

In stand-by, the data relevant to forces, moments and switches are all at "zero". A force of positive sign increases the relevant datum up to 7FH, and decreases it on the contrary; in the same way, a clockwise rotation increases the relevant datum, and decreases it on the contrary; the activation of a switch sets to "one" the relevant bit.

CALCULATION MATRIX

The 'force control grip' has two resistances for each axis, connected as shown below:



On the interface board there is a trimmer for the setting of zero.
The six analog signals are read by the microcontroller through the A to D converter, and are processed by the following matrix:

$$\begin{bmatrix} Ux \\ Uy \\ Wz \\ Uz \\ Wx \\ Wy \end{bmatrix} = a \begin{bmatrix} -1 & -1 & 2 & .0 & 0 & 0 \\ SQR(3) & -SQR(3) & 0 & 0 & 0 & 0 \\ -2 & -2 & -2 & 0 & 0 & 0 \\ 0 & 0 & 0 & -2 & -2 & -2 \\ 0 & 0 & 0 & 1 & 1 & -2 \\ 0 & 0 & 0 & -SQR(3) & SQR(3) & 0 \end{bmatrix} \begin{bmatrix} I1t \\ I2t \\ I3t \\ I1s \\ I2s \\ I3s \end{bmatrix}$$

where a=1/6 (sensibility coefficient)

The elements of the resulting vector are further processed to introduce a "dead zone" near zero, according to the following diagram: